

Energy Tips



Steam



Motors



Compressed Air

Monitor Flue Gas Temperature

An indirect indicator of scale or deposit formation is flue gas temperature. If the flue gas temperature rises (with boiler load and excess air held constant), the effect is possibly due to the presence of scale.

Perform Visual Inspections

Visually inspect boiler tubes when the unit is shut down for maintenance. Scale removal can be achieved by mechanical means, or acid cleaning. If scale is present, consult with your local water treatment specialist and consider modifying your feedwater treatment or chemical additives schedule.

Clean Boiler Water-side Heat Transfer Surfaces

Even on small boilers, the prevention of scale formation can produce substantial energy savings. Scale deposits occur when calcium, magnesium, and silica, commonly found in most water supplies, react to form a continuous layer of material on the waterside of the boiler heat exchange tubes.

Scale creates a problem because it typically possesses a thermal conductivity an order of magnitude less than the corresponding value for bare steel. Even thin layers of scale serve as an effective insulator and retard heat transfer. The result is overheating of boiler tube metal, tube failures, and loss of energy efficiency. Fuel wastage due to boiler scale may be 2% for water-tube boilers and up to 5% in fire-tube boilers. Energy losses as a function of scale thickness and composition are given in the table below.

Energy Loss Due to Scale Deposits*

Scale Thickness, inches	Fuel Loss, % of Total Use		
	"Normal"	Scale Type High Iron	Iron plus Silica
1/64	1.0	1.6	3.5
1/32	2.0	3.1	7.0
3/64	3.0	4.7	–
1/16	3.9	6.2	–

Note: "Normal" scale is usually encountered in low-pressure applications. The high iron and iron plus silica scale composition results from high-pressure service conditions.

*Extracted from National Institute of Standards and Technology, Handbook 115, Supplement 1.

Example

A boiler annually uses 450,000 million Btus (MBtu) of fuel while operating for 8000 hours at its rated capacity of 45,000 pounds-per-hour (lbs/hr) of 150-psig steam. If scale 1/32nd of an inch thick is allowed to form on the boiler tubes, and the scale is of "normal" composition, the table indicates a fuel loss of 2%. The increase in operating costs, assuming energy is priced at \$3.00/MBtu, is:

$$\begin{aligned}\text{Annual Operating Cost Increase} &= 450,000 \text{ MBtu/year} \times \$3.00/\text{MBtu} \times 0.02 \\ &= \$27,000\end{aligned}$$

Suggested Actions

Any scale in a boiler is undesirable. The best way to deal with scale is not to let it form in the first place. Scale formation is prevented by:

- pretreatment of boiler makeup water (using water softeners, demineralizers, and reverse osmosis to remove scale-forming minerals),
- chemical injection into the boiler feedwater, and
- adopting proper boiler blowdown practices.

Adapted from an Energy TIPS fact sheet that was originally published by the Industrial Energy Extension Service of Georgia Tech. For additional information on industrial energy efficiency measures, contact the OIT Clearinghouse at (800) 862-2086.



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- ☐ Energy Management for Motor Driven Systems
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Access the Web site at www.motor.doe.gov.

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- ☐ Plant Services Article - *The Steam Challenge*
- ☐ Energy Manager Article - *Steaming Ahead*
- ☐ Oak Ridge National Laboratory's Insulation Guidelines
- ☐ 1998 IETC Steam Session Papers

Case Studies -

- ☐ Georgia Pacific Achieves 6-Month Payback
- ☐ Bethlehem Steel Showcase Demonstration

Software -

- ☐ 3EPlus Software for Determining Optimal Insulation Thickness

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(For schedule and location, call (800) 862-2086)

Access the Web site at www.knowpressure.org.

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Documents -

- ☐ IAC Database

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